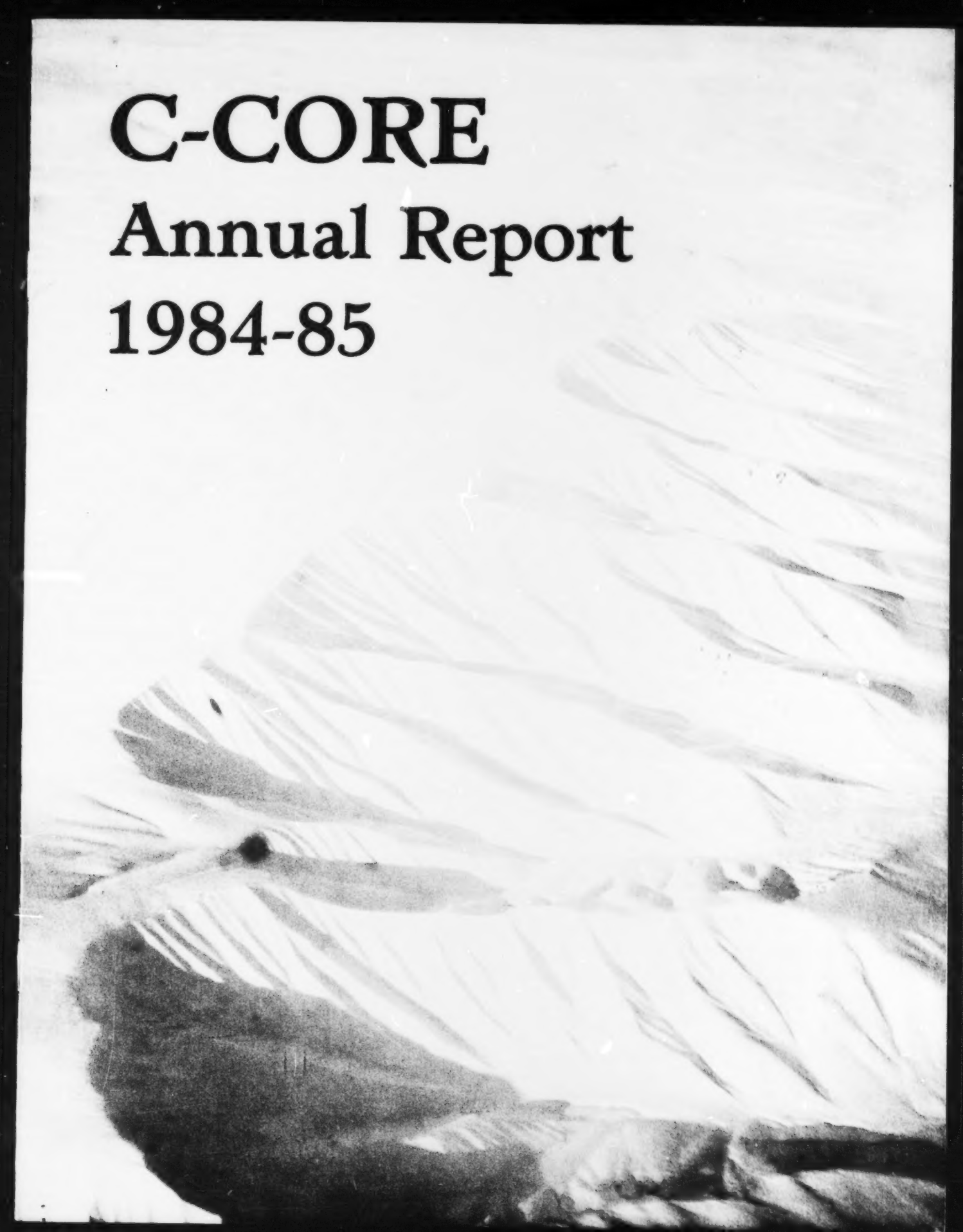
C-CORE
Annual Report
1984-85



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Dan R. Motyka

I am pleased to assume the responsibilities of Chairman of the Board of Governors, and to follow in the footsteps of Dr. Angus Bruneau who made such a significant contribution to the establishment and growth of the Centre. With his inspired leadership, a Canadian presence with an international reputation for excellence has been achieved in cold ocean technology.

Offshore activities on the east coast and in the Beaufort Sea will make 1985-86 a challenging year for C-CORE. The **Message from the Director** focuses on the importance of having a positive commitment from industry and government to support research and development in centres such as C-CORE. This will ensure the continuing Canadian presence in offshore technology required to develop our own resources.

This year, the members of the Board and I look forward to working with you to achieve this worthwhile goal.

The Centre for Cold Ocean Resources Engineering (C-CORE) was established at Memorial University of Newfoundland in St. John's in 1975. Its initial funding was provided by the Devonian Group of Charitable Foundations of Calgary. Ongoing funding now comes from government and industry.

The Centre's mandate is to undertake research that will assist the safe and orderly development of Canada's resources in cold and ice frequented oceans.

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Cover: Aerial view between Pond Inlet and Adams Island, N.W.T. (photo Jean-Paul Nadreau)

Message from the Director

C-CORE has now completed 10 years of research in Canada's cold ocean regions. Over these years we have addressed a wide spectrum of engineering and scientific concerns. These have evolved into three distinct thrusts: **seabed geotechnics,** integrating geology, geophysics and geotechnical engineering; **ice research,** emphasizing ice properties and ice dynamics; and **remote sensing,** exploring radar techniques for ice and ocean hazard detection.

The dream of a few has become a reality that has received tremendous support from many — the Devonian Group of Charitable Foundations, Industry, the Government of Canada, the Government of Newfoundland and Labrador and Memorial University. There is no doubt, however, that during those early years many supporters viewed C-CORE as an experiment.

So how has the experiment worked? Look at productivity. **Over 200 research reports** published in the Canadian and international technical literature have been widely disseminated and many of them serve as benchmarks in cold ocean research. **Over 100 students** have participated in the strongly field orientated research projects in preparation for future jobs in industry or government. **Over 60 researchers** have been involved in C-CORE activities for periods of a few months up to several years. Now, two-thirds of them work in industry and one-third in universities and government. **Sixteen graduate students** sponsored by C-CORE for graduate work in Ocean Engineering at Memorial University, have strengthened the Canadian technical capability so necessary in the development of our own ocean resources.

The **Ocean Engineering Information Centre** managed by C-CORE is an internationally recognized and widely used reference source for cold ocean researchers, designers and builders. The **Canadian Sea Ice Information System,** a world class database developed and managed by C-CORE, responds to requests for ice data from many agencies and groups.

Most importantly, we have assembled **a dedicated and talented research staff,** now numbering 35, many of whom are recognized internationally. We have reached 'critical mass' in all three research thrusts. Our research groups have specific objectives but of equal importance, they have budgets and schedules.

C-CORE has developed close working relationships with other Canadian research organizations and universities with programs in cold ocean engineering research. We draw upon each other's strengths and we participate in joint activities to avoid duplication of effort. **C-CORE's five year research plan, 1985-1990** has been widely distributed to ensure that all sectors involved in cold ocean resource development are aware of what is happening at C-CORE.

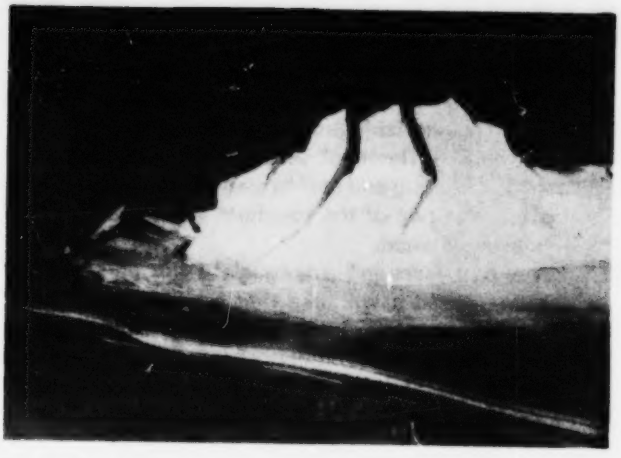
So, by any standard, **the experiment has been a success.** Those who had the dream and those who made it a reality are justifiably proud of what they have achieved for Canada. Those of us who are responsible for managing, directing and implementing the research plan, however, face two of the toughest years that C-CORE will ever experience.

Why two years and why tough? Two years because we estimate that it will take that long before offshore development reaches the stage when industry will be making significant commitments for research to support production. Tough because these are very tough times to finance research in Canada. C-CORE is totally self-reliant. Government support has softened substantially because various ministries that supported C-CORE are now faced with budget cuts and restrictions on expenditures.

Over the next six months we will be asking past, present and potential supporters to take a hard look at the C-CORE research product and the extent of their commitment and support. Our research plan is responsive to the needs that you and others in your organizations, both government and industry, have identified as being of highest priority. We have the structure and the links with other agencies and organizations to achieve the identified objectives. If C-CORE is to maintain and strengthen the level of competence so essential to the management of Canada's cold ocean resources, we must have your support. What we need now is hard cash.

Traditionally C-CORE has been supported by industry, federal and provincial governments. If support from any of these sources weakens, we will pursue every available alternative. We must not allow this national asset to be lost. One alternative would be to compete aggressively with other private organizations for project work. We feel, however, that this would be wrong. The last thing Canada needs is another consulting organization. What it does need is an organization that works with industry, government and academia, drawing upon the tremendously capable but thinly spread talents of the Canadian technical community and focusing those talents on important problems in cold ocean resource development. This is what C-CORE does, and has been doing for 10 years. The experiment was a success; the dream is a reality. C-CORE is an important Canadian asset that is worth preserving. We need your support now.

Jack I. Clark



Pressure ridge — Adams Island, N.W.T.

ICE

Wave/Iceberg Interaction

A field program provided full scale data on wave-induced motion of small icebergs and bergy bits and verified the results of model and theoretical studies. C-CORE constructed a sensing package for helicopter deployment directly onto icebergs and bergy bits to measure instantaneous ice motion in ocean waves in the field.

A second set of packages was developed for longer-term deployment; for the first time actual iceberg dynamics during a scour were obtained. The 1985 field program to study the wave-induced motion of small ice masses was coupled with the Environmental Studies Revolving Funds (ESRF) experiment to study the dynamics of icebergs grounding and scouring (DIGS '85).

Iceberg Temperatures/Fragmentation

Core temperatures and the thermal gradient of icebergs provide valuable information for use in ice management. Iceberg temperature information was obtained and attempts were made to fracture large bergs by using controlled thermal energy deposition (thermit) to create large thermal stresses in the ice. A workshop in March 1985, discussed the *in situ* stresses in icebergs and means of exploiting these stresses to cause fragmentation of large bergs.

A large stable iceberg provided an opportunity to try slow thermal energy deposition as a fragmentation technique. Temperature and stress/strain measurements will be considered for the next stage of this work.

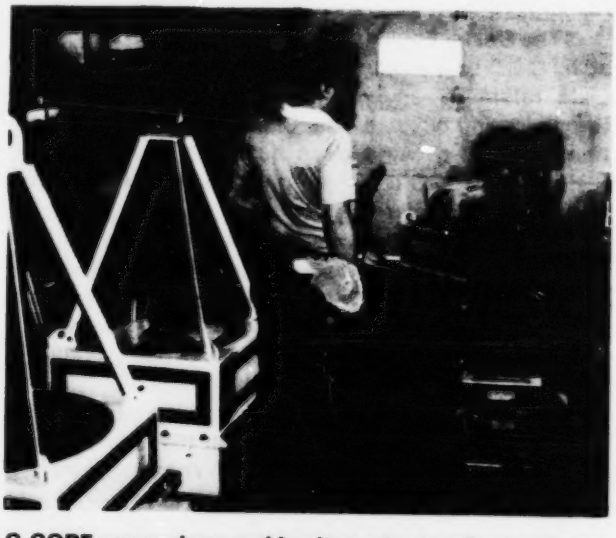
Canadian Sea Ice Information System (CSIIS)

The development phase of the on-line computer database, CSIIS, is complete. CSIIS is a database and information system which enables scientists and engineers to gain access to ice data collected from various consultant, industry and government reports. Both qualitative and quantitative ice information can be retrieved.

CSIIS which can be accessed internationally by the telecommunications networks is mounted on a computer at Memorial University. The purchase of the computer was made possible by a grant from the Government of Newfoundland and Labrador. The implementation phase of the system is being funded by the Canada Oil and Gas Lands Administration (COGLA). The development of the database was supported by funds from the Max Bell Foundation and COGLA.

Ice Properties

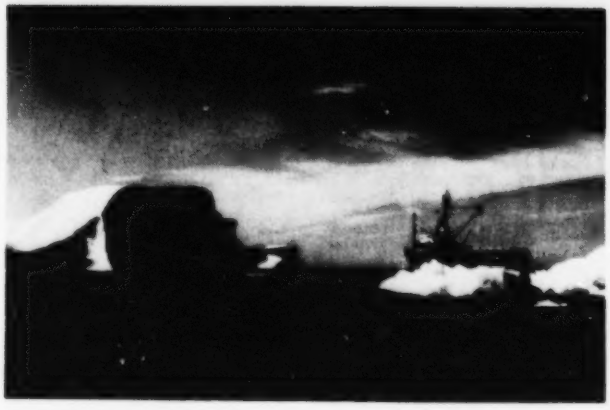
Work on ice microstructure was funded by the National Research Council of Canada and included a field program in the Arctic. A cooperative field program with the Institute for Marine Dynamics (IMD) on fracture toughness was also undertaken as part of the ice properties program. Future work in the program includes ice/structure interaction.



C-CORE researchers making last minute adjustments to the motion sensor packages

OCEAN ENGINEERING INFORMATION CENTRE

OEIC hosted an international northern information conference, attended by delegates from North America, Scandinavia and Europe. OEIC continued to make cold ocean engineering information readily available to the international scientific and engineering community responding to over 3000 requests for information. It also participated in a national information network Arctic Science and Technology Information System (ASTIS) transferring data onto the network in support of Canadian offshore activities.



Iceberg research in the summer off the coast of Labrador

REMOTE SENSING

Ice Hazard Detection

The Centre is continuing its program to apply ground wave radar technology for ice hazard detection with technical and financial support from the industrial Associates, in particular Mobil Oil Canada Ltd. and Petro-Canada Resources Inc. The objective of the program is to develop a rig-mounted ice sensor for operational use.

Much of the engineering effort has been focused on the development of an extended range iceberg detection sensor with two field programs to verify the theoretical models. The field work in Labrador concentrated on the measurement of radar cross-sections of icebergs with the narrow beam antenna. The results from the Labrador experiment confirm the predictions of the theoretical detection model that ice features do give a good detectable signal to the radar receiver. The Group has also been studying signal processing techniques to adapt broad beam antenna (physically, small antenna) for iceberg detection. We will be testing these methods to identify and track iceberg targets contained in our experimental records.

Oceanographic Remote Sensing

A cooperative program with the Atlantic Oceanographic Laboratory (AOL) of the Department of Fisheries and Oceans at the Bedford Institute of Oceanography (BIO) and Newfoundland Institute for Cold Ocean Science (NICOS) continues to apply the radar technology to ocean processes. In November the field program for the oceanographic component of the remote sensing program was conducted off Cape Sable in Nova Scotia. The field program was coordinated with AOL and logistic support was provided by the Canadian Coast Guard. Collaborative measurements of wave heights and current profiles were made and a series of overflights were conducted.

The program for next year will continue the field measurement of radar cross-sections of ice features including small ice masses, oceanographic work and involvement in the Canadian Atlantic Storms Program (CASP) for surface current mapping, and interpretation of the radar return for wave height and wave directional spectra.

Technical discussions regularly take place between the Associates and C-CORE's research staff. This ensures that our research directions remain relevant to the needs of offshore industry. Shown here, representatives of Petro-Canada Resources are reviewing the ground wave radar program with members of the Remote Sensing Group.

Jack Clark (centre) and Bill Collins (right) inspecting equipment to be used during a dive on the Canadian Forces' submersible *SDL-1*

SEABED

Hibernia Sediments Program

The Seabed Group undertook an investigation of available data to correlate shallow seismic reflection data, geological borehole analyses, geological features, clay and heavy mineralogy, and geotechnical data for the Hibernia area of the Newfoundland continental shelf. Cooperative programs were undertaken with the Atlantic. Geoscience Centre of the Department of Energy, Mines and Resources at the Bedford Institute of Oceanography.

In October 1984, C-CORE completed a submersible project in the Hibernia area with the Canadian Forces' vessel ***HMCS CORMORANT*** and the ***SDL-1*** five man submersible. The program investigated certain features in the Hibernia area, in particular, a 10 m deep pit located in the Mara wellsite area. At present the data have been analysed and laboratory experiments are being set up in order to test mechanisms of soil failure identified during this field program. Work also is continuing on borehole samples and cores to assist in the compilation of a preliminary geological map and cross-sections of the shallow stratigraphy for the Hibernia area of the Grand Banks.

Geotechnical Studies

One geotechnical study is focusing on structural and microstructural changes and associated geotechnical properties of the sediments. Results will yield insights into the potential engineering significance that soils found on the continental rise may have with respect to exploration. Other programs are being developed with the assistance of a senior geotechnical engineer on secondment from Gulf Canada Ltd.

Probability of Grounding and Scouring of Icebergs

A study on the grounding and scouring of icebergs using a data set of hourly observations of iceberg movement made from drilling ships by marine radar has been completed and published. Over 1,500 icebergs were studied. The study has shown that scouring icebergs may traverse significant ranges in bathymetry and suggests that scour tracks may reach lengths of 220 km. In November 1984, C-CORE was awarded funding by the Environmental Studies Revolving Funds (ESRF) for a study on upslope and downslope iceberg scouring.

Continental Slope

The objectives of this study are to detail the sediment instability processes operative on the east coast of Canada, investigate specific sites in terms of soil performance and seabed evaluation, and to assess oceanographic environmental conditions and their influence on the sedimentary system.

C-CORE and the Atlantic Geoscience Centre at Bedford Institute of Oceanography (BIO) participated in a joint geophysical Sea MARC sidescan sonar study of the Flemish Pass. Support was also provided by Esso Resources Canada Ltd.

Using the preliminary data obtained from this survey, experiments and further studies were undertaken this summer (1985) to determine the sedimentological/geotechnical characteristics of the continental slope, ages of iceberg scour populations and the development of a sediment dynamics model for the area.

Iceberg scour and flat-bottomed pit — Saglek Bank

DEPARTMENT OF THE AUDITOR GENERAL
ST. JOHN'S, NEWFOUNDLAND

AUDITOR'S REPORT

The Board of Regents
Memorial University of Newfoundland
St. John's, Newfoundland

I have examined the balance sheet of the Centre for Cold Ocean Resources Engineering as at 31 March 1985 and the statements of revenue, expenditure and surplus and changes in financial position for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Centre as at 31 March 1985 and the results of its operations and the changes in financial position for the year then ended in accordance with accounting principles described in Note 1 to the financial statements applied on a basis consistent with that of the preceding year.

J.F. McGrath, C.A.
Auditor General

St. John's, Newfoundland
24 July 1985

CENTRE FOR COLD OCEAN RESOURCES ENGINEERING
STATEMENT 1: BALANCE SHEET AS AT 31 MARCH 1985

		1985		1984
ASSETS				
Current assets:				
Research trust (Note 3)		$1,243,147		$1,087,700
Accounts receivable				
Operating	$199,978		$157,602	
Other (Note 9)	383,336		—	
	583,314		157,602	
Less: Allowance for doubtful accounts	3,874	579,440	—	157,602
Total current assets		1,822,587		1,245,302
Fixed assets — at cost				
Bartlett Building (Note 4)		1,038,841		1,038,841
Equipment (Note 5)	1,133,386		692,724	
Less: Accumulated depreciation	659,649	473,737	494,230	198,494
Total fixed assets		1,512,578		1,237,335
Total assets		$3,335,165		$2,482,637

	1985	1984
LIABILITIES AND EQUITY		
Current liabilities		
Accounts payable		
Operating	$ 50,511	$ 6,122
Current portion of deferred revenue	76,667	—
Due to Memorial University of Newfoundland (Note 9)	383,336	—
Total current liabilities	510,414	6,122
Long-term liabilities		
Interest-free advance from Memorial University of Newfoundland (Note 8)	265,598	315,598
Deferred revenue (Note 6)	230,002	—
Total long-term liabilities	495,600	315,598
Total liabilities	1,006,114	321,720
Equity		
Equity in research trust	1,243,147	1,087,700
Equity in building	1,038,841	1,038,841
Surplus	47,063	34,376
Total equity	2,329,051	2,160,917
Total liabilities and equity	$3,335,165	$2,482,637

See accompanying notes

CENTRE FOR COLD OCEAN RESOURCES ENGINEERING
STATEMENT 2: REVENUE, EXPENDITURE AND SURPLUS
FOR THE YEAR ENDED 31 MARCH 1985

	1985	1984
REVENUE		
Research trust drawdowns	$ 990,717	$ 792,744
Research contracts	557,167	518,615
Other	31,126	35,051
Total revenue	1,579,010	1,346,410
EXPENDITURE		
Staff salaries	856,668	777,745
Research programs	449,866	304,506
Support services	138,339	76,565
Ocean Engineering Information Centre	82,209	105,273
Fellowships and training	22,203	29,568
Board of Governors	17,038	13,915
Total expenditure	1,566,323	1,307,572
Surplus for the year	12,687	38,838
Surplus (deficit) — beginning of year	34,376	(4,462)
Surplus — end of year	$47,063	$34,376

See accompanying notes

CENTRE FOR COLD OCEAN RESOURCES ENGINEERING
STATEMENT 3: CHANGES IN FINANCIAL POSITION
FOR THE YEAR ENDED 31 MARCH 1985

	1985	1984
Sources of working capital		
From operations		
Surplus	$ 12,687	$ 38,838
Add: Item not affecting working capital		
Depreciation	165,419	106,344
Total sources from operations	178,106	145,182
Increase in interest-free advance	–	28,165
Net trust contribution (Note 3)	155,447	148,787
Deferred revenue (Note 6)	230,002	–
Total working capital provided	563,555	322,134
Application of working capital		
Repayment of interest-free advance	50,000	–
Purchase of fixed assets	440,662	124,914
Total working capital applied	490,662	124,914
Increase in working capital	72,893	197,220
Working capital – beginning of year	1,239,180	1,041,960
Working capital – end of year	$1,312,073	$1,239,180

See accompanying notes

Signed on behalf of Memorial University of Newfoundland

Chairman of the Board of Governors

Comptroller of Memorial University of Newfoundland

CENTRE FOR COLD OCEAN RESOURCES ENGINEERING
NOTES TO FINANCIAL STATEMENTS FOR THE YEAR ENDED 31 MARCH 1985

1. **Accounting policies**

(a) Basis of accounting

C-CORE follows the accrual basis of accounting except that contributions to C-CORE's research programs are deposited for credit to the C-CORE Research Trust, which is shown on a cash basis (Note 3).

(b) Depreciation

Depreciation is not recorded on the Bartlett Building (Note 4), however depreciation on other fixed assets is calculated on a straight line basis as follows:

Equipment	5 years
Tools and marine equipment	2 years
Computer software and other equipment	1 year

(c) Support-in-kind

Various services have been provided to C-CORE by Memorial University of Newfoundland and other agencies, without charge, and have not been included in these financial statements (Note 7).

2. **Relation to Memorial University of Newfoundland**

The Centre for Cold Ocean Resources Engineering (C-CORE) is a self-reliant organization of Memorial University which is owner of C-CORE's building and equipment and beneficiary of its assets and liabilities. In the event that C-CORE is terminated, facilities and equipment provided or acquired for C-CORE shall remain the absolute property of the University.

As such, these financial statement figures represent a segment of the activities of Memorial University of Newfoundland and are included in the audited financial statements of the University for the year ended 31 March 1985.

3. **Funds in Research Trust**

The Comptroller of Memorial University of Newfoundland administers the C-CORE Research Trust on behalf of the Trustee, the Board of Regents of Memorial University.

Cash transactions in the Research Trust during the year were as follows:

Balance in bank, 1 April 1984	$1,087,700
Receipts:	
Industry	718,100
Government of Canada	304,987
Investment income	123,077
	1,146,164
Less: Transferred to the Centre's operations	990,717
Net contribution during the year	155,447
Balance in bank, 31 March 1985	$1,243,147

4. **Bartlett Building**

In order to properly reflect the entire operations of C-CORE as a separate entity, the Bartlett Building, which is owned by Memorial University of Newfoundland but of which C-CORE has exclusive use, has been included in the financial statements for 1985 and 1984 at a cost of $1,038,841.

continued on page 10.

5. **Equipment**

C-CORE accounts for its equipment in three main categories, as outlined in Note 1.

Category	Acquisitions	Accumulated Depreciation	Net Book Value 1985	Net Book Value 1984
Equipment	$1,024,160	$550,423	$473,737	$198,337
Tools and marine equipment	89,778	89,778	–	157
Computer software and other equipment	19,448	19,448	–	–
	$1,133,386	$659,649	$473,737	$198,494

C-CORE has recognized Government contributions of $383,336 during the year in respect of the purchase of a computer, the cost of which is included in equipment acquisitions as at 31 March 1985. The Province of Newfoundland has secured its contribution of $191,668 by way of a chattel mortgage, which shall be forgiven by the Province over a four year period at a rate of 25% per year. The balance of $191,668 is comprised of a grant from the Government of Canada. Terms of this contracted contribution require C-CORE to provide for the implementation and provision of a Sea Ice Data Base Service over the period from 22 January 1985 to 31 March 1989.

6. **Deferred revenue**

Government contributions of $383,336 (see Note 5) have been recorded as deferred revenue to be amortized to revenue over a five year period on a straight line basis. Of this amount, $76,667 has been included in revenue for the year ended 31 March 1985.

7. **Support-in-kind**

Management has estimated the cost of various services provided without charge by Memorial University of Newfoundland and other agencies at $400,630 for the year ended 31 March 1985 ($358,800 – 1984).

8. **Interest-free advance**

The interest-free advance of $265,598 ($315,598 – 1984) is repayable to Memorial University of Newfoundland. It is the intention of C-CORE to make annual payments of $50,000 in each of the next five years.

9. **Accounts receivable – other**

Accounts receivable – other is comprised of $191,668 due from the Government of Canada and $191,668 due from the Province of Newfoundland in respect of the purchase of a new computer system during the year. This purchase was made by Memorial University on behalf of C-CORE, pending receipt of this funding, thus a total of $383,336 is due to the University as at year end.

Board of Governors

The Board of Governors of C-CORE is responsible for the funding, research activities, policy direction and management of C-CORE.

Dr. Angus A. Bruneau
Chairman 1984-85
President, Bruneau Resources Management Ltd.

Mr. Dan R. Motyka
Chairman, 1985-86
Vice-President, Production
Gulf Canada Ltd.

Dr. Jack I. Clark
Director, C-CORE
Memorial University of Newfoundland

Dr. Christopher Barnes
Head, Earth Sciences
Memorial University of Newfoundland

Mr. Herb M. Clarke
Clerk of Executive Council
Government of Newfoundland and Labrador

Dr. Art E. Collin
Secretary & Chief Science Advisor
Ministry of State for Science and Technology
Government of Canada

Mr. Craig Dobbin
Chairman of the Board
Sealand Helicopters

Mr. G. Campbell Eaton
Chairman
Seabase Ltd.

Mr. Gerry N. Ewing
On leave from:
Dept. of Fisheries and Oceans
Government of Canada
Presently with C-FER, Atlantic

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Vice-President and General Manager
Esso Resources Canada Ltd.

Mr. Harold Lundrigan
President
Lundrigan Group Ltd.

Dr. G. Ross Peters
Dean of Engineering and Applied Science
Memorial University of Newfoundland

Dr. Ross Pottie
Vice-President
Physical Sciences and Engineering
National Research Council Canada

Mr. Jim Stanford
President
Petro-Canada Resources

Mr. W. Wayne Thistle
Vice-President
Administration and Finance
Memorial University of Newfoundland

Secretary:

Ms. Judith A. Whittick
Administrator, C-CORE
Head, OEIC

Assistant Secretary:

Ms. Sherilyn Beaton
Projects Controller
C-CORE

C-CORE Associates 1984-85

Industries and Government Agencies Contributing Financial and Logistic Support to the Research Programs of C-CORE

Bechtel Canada Ltd.
F.G. Bercha and Associates Ltd.
BP Canada Inc.
Bow Valley Industries Ltd.
Brown & Root Ltd.
CN Marine
Canadian Superior Oil Ltd.
CANPOLAR Consultants Ltd.
Canterra Energy Ltd.
Det norske Veritas (Canada) Ltd.
Dobrocky Seatech Ltd.
Dome Petroleum Ltd.
Energy, Mines and Resources Canada
Esso Resources Canada Ltd.
Fenco Newfoundland Ltd.
Fisheries and Oceans Canada
GEOTECHnical Resources Ltd.
Golder Associates
Gulf Canada Ltd.
Husky Oil Operations Ltd.
INSTRUMAR Ltd.
Mobil Oil Canada, Ltd.
National Research Council Canada
Newfoundland Geosciences Ltd.
NORDCO Ltd.
PanCanadian Petroleum Ltd.
Petro-Canada Resources Inc.
Royal Bank of Canada
ShawMont Newfoundland Ltd.
Shell Canada Resources Ltd.
Texaco Canada Resources Ltd.
Transport Canada
Viatec Resource Systems Inc.
Westinghouse Canada Inc.
Wolf Sub-Ocean Ltd.

Reports and Publications for 1984

84- 1 Stander, E. "The Petrography of a Vertically Sectioned First Year Sea Ice Core". Proceedings of the 3rd International Offshore Mechanics and Arctic Engineering (OMAE) Symposium. New Orleans, U.S.A., February 1984, 196-203.

84- 2 Winacott, E.L., Roche, C. and Chan, J.Y.K. "The Canadian Programme of Experimental Measurement of Sea-State Characteristics by Sky-Wave Radar". Propagation Factors Affecting Remote Sensing by Radio Waves, AGARD Conference Proceedings No. 345, Oberammergau, W. Germany, May 1983, 14-1 to 14-17.

84- 3 Christian, D. "The Development of C-CORE's Seabed Coring Device". Technical Report, March 1984, 57 p.

84- 4 Pereira, C.P.G., Woodworth-Lynas, C.M.T. and Barrie, J.V. "Davis Strait Iceberg Scouring Analysis". Technical Report, December 1984, 78 p.

84- 5 Collins, W.T., Barrie, J.V. and Woodworth-Lynas, C.M.T. "Iceberg Scouring and Sediment Dynamics on the Labrador Shelf". 35 minute colour video cassette, February 1984.

84- 6 Christian, D., Diemand, D., Lever, J., Parsons, B., Snellen, J.B., Stander, E. and Woodworth-Lynas, C. "Observations from an Iceberg in Freshwater Bay, St. John's". Data Report, February 1984, 13 p.

84- 7 Lever, J., Reimer, E. and Diemand, D. "A Model Study of the Wave-Induced Motion of Small Icebergs and Bergy Bits". Proceedings of the 3rd International Offshore Mechanics and Arctic Engineering (OMAE) Symposium. New Orleans, U.S.A., February 1984, 282-290.

84- 8 Woodworth-Lynas, C.M.T. and Rendell, C.M. "Grounding and Scouring Icebergs on the Labrador Shelf". Iceberg Research, No. 7, March 1984, 13-20.

84- 9 Diemand, D. "Iceberg Temperatures in the North Atlantic — Theoretical and Measured". Cold Regions Science and Technology, 9(1984), 171-178.

84-10 Harmon, D.J. "An Instrumented Ice Auger". Proceedings of International Association for Hydraulic Research (IAHR), Ice Symposium 1984, Hamburg, W. Germany, Aug. 27-31, 1984, 385-391.

84-11 Harmon, D.J., Roche, M.C. and Ruck, C.G. "The Canadian Sea Ice Guide — An Overview". Proceedings of the 1984 National Engineering Conference Week, Halifax, N.S., May 20-25, 1984, sponsored by the Canadian Society of Civil Engineering.

84-12 Goodwin, C.R., Whittick, J.A., Howard, L.M., Finley, J.C. and Rodden, B.D. (Eds.) "Cold Ocean Engineering Bibliography". June 1984. A joint publication of ASTIS (Arctic Science and Technology Information System) and C-CORE, 169 p.

84-13 Klein, K., Winsor, W.D. and Hickey, K.J. "Radar Propagation and Backscattering Predictions for a CODAR System Operating in Brackish Waters". Contract report for Department of Fisheries and Oceans. C-CORE Technical Report, August 1984, 123 p.

84-14 Diemand, D. "Temperatures of Near Shore Icebergs in the St. John's Area 1983". Data Report, November 1984, 55 p.

84-15 Woodworth-Lynas, C.M.T., Simms, A. and Rendell, C.M. "Iceberg Grounding and Scouring on the Labrador Continental Shelf". Cold Regions Science and Technology, 10(1985), 163-186.

84-16 Woodworth-Lynas, C.M.T., Simms, A. and Rendell, C.M. "Iceberg Grounding and Scouring Frequency, Labrador Sea". Conference Record of Oceans '84, Washington, D.C., September 10-12, 1984, sponsored by Marine Technology Society and IEEE Ocean Engineering Society, Volume 1 of 2, 259-262.

84-17 Barrie, J.V., Collins, W.T., Woodworth-Lynas, C.M.T. and Christian, D. "Geological Investigations from the Hibernia Borehole Program". Contract Report for Geological Survey of Canada.

84-18 Diemand, D. "A Shoulder-Launched Projectile for Subsurface Measurement of Iceberg Temperatures". Workshop on Ice Penetration Technology, June 12-13, 1984 at U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, N.H., CRREL Special Report 84-33, December 1984, 197-207.

84-19 Whittick, J.A. and Rodden, B.D. (Eds.) "Proceedings of the Tenth Northern Libraries Colloquy". Memorial University of Newfoundland, St. John's, August 12-16, 1984. C-CORE Publication, November 1984, 464p.

Reports and Publications for 1985

85-1 Stander, E. "The Measurement and Analysis of Strainmeter Data from Adams Island, Navy Board Inlet, N.W.T.". Contract Report for National Research Council of Canada, C-CORE Technical Report, April 1985, 34 p.

85-2 Diemand, D. "Iceberg Fragmentation by Thermal Shock". Iceberg Research, No. 8, October 1984, 8-10.

85-3 Pereira, C.P.G. and Gillespie, R.T. "Davis Strait: Marine Geology, Sedimentology and Iceberg Scouring Analysis — Final Report". C-CORE Technical Report, June 1985, 46 p.

85-4 Winsor, W.D., Shirasawa, K., Hickey, K.J., Arscott, D.G. and Hay, A.E. "HF Radar Remote Sensing of the Surface Currents in the Strait of Belle Isle". Proceedings of the Ninth Canadian Symposium on Remote Sensing, St. John's, Nfld., August 14-17, 1984, 203-212.

85-5 Donnelly, R., Jeans, P.K. and Arscott, D.G. "Applications of Spectral and Bearing Estimation Techniques to a Four Element Array used to Measure Ocean Currents". Proceedings of the Ninth Canadian Symposium on Remote Sensing, St. John's, Nfld., August 14-17, 1984, 213-223.

85-6 Gillespie, R.T. and Rendell, C.M. "Centre for Cold Ocean Resources Engineering Sedimentation Tube: User Manual". Technical Report, May 1985, 41 p.

85-7 Barrie, J.V., Collins, W.T. and Segall, M.P. "Holocene Development and Sediment Transport on the Northeastern Grand Banks of Newfoundland". Contract Report for Energy Mines and Resources.

85-8 Gilbert, G.R. and Barrie, J.V. "Provenance and Sedimentology Processes of Ice Scoured Surficial Sediments, Labrador Shelf". Canadian Journal of Earth Sciences, Vol. 22, No. 7, 1985, 1066-1079.

85-9 Segall, M.P., Barrie, J.V., Lewis, C.F.M. and Maher, M.L.J. "Clay Minerals across the Tertiary Boundary Northeastern Grand Banks of Newfoundland: Preliminary Results". Current Research, Part B, Geological Survey of Canada Paper 85-1B, 63-68, 1985.

85-10 Pereira, C.P.G., Piper, D.J.W. and Shor, A.N. "Sea MARC I Midrange Sidescan Sonar Survey of Flemish Pass, East of the Grand Banks of Newfoundland". Contract Report, Geological Survey of Canada, Open File 1161.

85-11 Woodworth-Lynas, C.M.T., Day, T., Christian, D. and Seidel, M. "Surveying and Trenching an Iceberg Scour, King William Island, Arctic Canada". Iceberg Research, No. 10, April 1985, 1-8.

85-12 Collins, W.T. and Barrie, J.V. "Preliminary Submersible Observations of an Iceberg Pockmark on the Grand Banks of Newfoundland". Iceberg Research, No. 10, April 1985, 24-27.

85-13 Lever, J.H. and Diemand, D. "Measurement of Instantaneous Motions of Ice Masses at Sea: 1984 Pilot Program". Proceedings of the 8th International Conference on Port and Ocean Engineering Under Arctic Conditions (POAC '85), Narssarssuaq, Greenland, September 6-13, 1985, Vol. 2, 988-997.

85-14 Woodworth-Lynas, C.M.T. and Barrie, J.V. "Iceberg Scouring Frequencies and Scour Degradation on Canada's Eastern Shelf Areas using Sidescan Mosaic Remapping Techniques". Proceedings of the 8th International Conference on Port and Ocean Engineering (POAC '85), Narssarssuaq, Greenland, September 6-13, 1985, Vol. 1, 419-442.

85-15 Dawe, C.R. and Chari, T.R. "Dynamic Effects of Waves on Seabed Stability". Proceedings of Canadian Coastal Conference 1985, St. John's, Nfld., August 13-16, 1985, 177-187.

85-16 Walsh, J., Dawe, B.J. and Srivastava, S.K. "A New Iceberg Detection System: Ground Wave Doppler Radar". Proceedings of IEEE Electronicom '85, Toronto, October 7-9, 1985, Vol. 1 of 3, Paper No. 85094, 220-222.

Information Publications

84-A to 84-E — See C-CORE News Vol. 9, No. 3, November 1984 for listing.
85-A to 85-J — See C-CORE News Vol. 10, No. 3, November 1985 for listing.